Class I. HEXAPODA.

Order IX, HEMIPTERA.

THE GENUS NOTONECTA IN AMERICA NORTH OF MEXICO.

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(Plate VII.)

The Notonectidæ are one of the most interesting and, as far as coloration goes, handsomest families of the Cryptocerate Hemiptera, while the genus of which I treat is certainly the most brilliant in hues, nearly every species being of some striking color. But, as I have pointed out on other occasions,* these are much neglected groups, and while some little work has been done in Europe in past times by the great masters F. X. Fieber, G. Mayr, Léon Dufour and others, and of late years by their learned successors, George W. Kirkaldy and Prof. A. L. Montandon, specialists in these families, in America nothing has been produced to compare with their work, save, perhaps, by Prof. Uhler, who is easily the premier American Hemipterist. Yet even he has taken up these neglected groups only as they came within the general scope of his specialty. The other Heteroptera are studied with greater or less closeness in proportion as they are hurtful or harmless, and most of them receive the special attention of the economic entomologist, but the aquatic forms are little collected and still less studied. Nevertheless, there is an economic aspect to these groups. Being predaceous, they are useful or harmful according to their prey. The great water-bugs of the family Belostomidæ are stated by Uhler,† Howard ‡ and others § to be harmful where pisciculture is practised, as they are destructive to young fish. May not

* "Notonectidæ of the Vicinity of New York," Journ. N. Y. Ent. Soc., X, 4, 1902. "Brief Notes toward the Life-History of Pelocoris femorata Pal. B., with a few remarks on habits," *ibid.*, XI, 3, 1903.

† Standard Natural History, II, p. 256.

‡ Insect Book, p. 278.

§ Proc. Ent. Soc. Wash., III, 2, pp. 87–88.

the Notonectæ likewise destroy such as are sufficiently small to be overcome by them? I have seen nymphs of *Notonecta undulata* Say in the second instar kill and suck the juices of young fish which had just emerged from the egg in my aquaria. Prof. S. A. Forbes's two papers on the food of fresh-water fishes, in the Bulletin of the Illinois State Laboratory of Natural History * show that they are of very little account as fish food. He says (*l. c.*); "Indeed, the true Waterbugs (Hemiptera) were generally rare, with the exception of the small soft-bodied genus *Corixa*, which was taken by one hundred and ten specimens, belonging to twenty-seven species — most abundantly by the sunfishes and top-minnows." Further on in the paper he tabulates the families, and in some instances, species, of insect fish-food, and contrasting with the number of fish above mentioned that ate Corixas, only *one* fish was found to have fed on Notonectas, out of the entire number examined.

Because of their apparent lack of economic importance, the knowledge of American forms is very imperfect and but scant information is available regarding their distribution, habits, life-history and anatomy. This I have found at every turn while consulting authorities. For this reason in the following pages I will endeavor to make it possible for anyone to identify with very little trouble any of the species of the genus *Notonecta* that occurs north of Mexico; and by thus facilitating this identification and by pointing out gaps in our knowledge that might readily be filled, especially in distribution, induce others to collect and study a group which I am certain will be found eventually to be of positive economic importance, not only as an enemy in fish-culture, but possibly also in useful ways by the destruction of undesirable aquatic larvæ. The figures illustrating the various species will enhance the value of this paper, being true to nature and showing very perfectly the different physical characteristics of the waterbugs, being drawn to scale and in perfect proportion. They are the work of Mrs. William Beutenmüller, who is, I consider, one of our foremost insect artists. I here wish to express my appreciation of her great kindness in consenting to make these drawings.

The genus *Notonecta* Linné is of world-wide distribution, but appears to be more especially an American group. Of its twenty species

* "Studies on the Food of Fresh Water Fishes," Art. VII, Vol. II. "On the Food Relations of Fresh Water Fishes: A Summary and a Discussion," Art. VIII, Vol. II.

no less than twelve are peculiar to America, the thirteenth being European and Asiatic, also of these thirteen, eleven are to be found north of Mexico, three being, so far as records show, strictly boreal. It is not safe, however, to generalize regarding such variable and little-known insects, since errors readily arise from this practice. The described and recorded North American forms are *Notonecta indica* Linné (= *americana* Fabricius*), *N. undulata* Say, *N. variabilis* Fieber, *N. uhleri* Kirkaldy, *N. mexicana* Amyot & Serville, *N. irrorata* Uhler, *N. lutea* Muller, *N. shooteri* Uhler, *N. insulata* Kirby, *N. montezuma* Kirkaldy, to which I add a new species, *N. howardii*.

Notonecta indica Linné is peculiarly a subtropical form and is found only in the warmer portions of the South and West, while *N. undulata* Say is of the widest distribution, ranging to my knowledge, from as far North as British Columbia and going down as far as Chile in South America, according to Kirkaldy. The distribution of *N. variabilis* Fieber is not so well known, but it is commonly found in the greater part of the United States. The very few recorded captures of *N. uhleri* Kirkaldy make it very difficult to fix its limits, but it is certainly to be found all along the Atlantic and Gulf seaboards of the United States. *N. mexicana* Amyot & Serville is more peculiarly tropical, but it comes in along our Southwestern boundary where the climate is warmer, extending up along the Pacific Slope for some distance, which appears to be the case also with *N. shooteri* Uhler and *N. montezuma* Kirkaldy, while on the other hand *N. irrorata* Uhler seems to be northern and eastern, being found only in the colder sections. In *N. insulata* Kirby we have a very peculiar distribution, the bug being in the East apparently boreal, but in the West it goes down into the warmer portions of the country. In *N. lutea* Muller we have an addition to our fauna, of much interest since the insect has heretofore been recorded only from Europe and Siberia.†

Considering the United States only, I have been unable to find any records of Notonecta from the following states: New Hampshire, Vermont, Deleware, West Virginia, South Carolina, Georgia, Mississippi, North Dakota, Alabama, Washington, Wyoming, and Arkansas, and Indian and Oklahoma Territories. The insect must certainly occur in them, since they are found in the neighboring ones. They must, for instance, be found in New Hampshire and Vermont, since

* Kirkaldy gives the Synonymy in "Über Notonectiden."

† Bueno, "A Palæartic Notonecta," Entomological News, XV, p. 220, June, 1904.

they occur in Massachusetts, New York, Maine, and the province of Quebec in Canada. I trust these gaps will be filled before long.

The habits of the Notonectæ are more or less well-known. They are exceedingly active and fiercely predaceous, resembling nothing so much as hawks among vertebrates. Their principal prey are such unfortunate insects as fall into the water within the ken of the watchful waterbug, or such of the feebler aquatic insects they can overcome, not disdaining their own young. From their position hanging back down at or near the surface, nothing escapes them, and at the slightest vibration imparted to the water by any struggling insect, or the least motion of one swimming by, they wheel swiftly about and with one or two powerful strokes of their long swimming legs, are on their prey and have it seized in their strong raptorial first and second pair of legs. They are strong and vigorous swimmers, and it is no great effort for a *Notonecta*, to pull under water and swim away with a struggling insect at least its own size, if not larger. I have, as before noted, seen a young nymph swim away with a fish at least twice its own size. Not all Notonectas hang from the surface constantly, however. *Notonecta undulata* does, and its raptorial claws can be seen forming little elevations as it hangs head down, while *N. insulata* seems to prefer to float in clear spaces in clean cold pools, about midway between the bottom and surface. On the other hand, *N. irrorata* and *N. uhleri* appear to like to hide among the roots of plants growing at the water's edge, to which they cling. The former may at other times also be seen floating below the surface in the shadow cast by bank or fallen tree or broken branch. The habits of *N. variabilis* differ somewhat from the others, since this bug prefers to lurk among the water weeds at the bottom.

The oviposition of *Notonecta* has thus far been always described from Régimbart's paper* and the statement that the ova are buried in the stem of a plant has been handed down from generation to generation of entomologists as a precious heirloom, without question and without doubt. However, out of about 1,300 or 1,400 ova of four or five species that I have seen, some deposited in my aquaria and others taken in nature, I have thus far not found this so, save in the instance of one *N. undulata*, which did indeed insert them quite deeply in the stem of a water weed. All the others were simply

* "Observations sur la Ponte du *Dytiscus marginalis* et de quelques autres Insectes Aquatiques," Ann. Soc. Ent. Fr., 1875, p. 204.

attached in the manner described further on, although the plants in my aquaria were the same as for the one specimen, and although in the open I have found the ova on the watersoaked and decaying stems of rushes. It may well be, nevertheless, that since the bug observed by Régimbart was the European *Notonecta glauca* Linné its habits in this respect may differ from those of the American species I have been able to observe.

A word regarding collection and preservation of these waterbugs may not be amiss. Any approved water net will do. I use one made of coarse Brussels net, which is very strong and at the same time permits the water to flow through quickly, thereby offering very little resistance in the rapid movements necessary to secure these agile swimmers. The handle also should be rather long to give a good reach. To capture *Notonecta undulata*, the net should be moved swiftly back and forth just under the surface of the water at first; then when the bugs are hiding the vegetation should be dragged, the latter being also the best way to get *N. variabilis*. *Notonecta uhleri* and *N. irrorata* are best taken by dragging along the vegetation growing into the water from overhanging banks, not too near the surface, a tangle of roots in the water being in my experience the best place. For *N. irrorata*, the shadow of logs or broken branches lying in the water is a very favorable situation, and if the log lies in the water or floats on it the net should scrape the submerged surfaces. *Notonecta insulata* can be taken as it floats in the water by approaching the net slowly to the insect and then making a swift stroke, so that it meets the bug as it swims away. When under cover, the vegetation should be dragged as for the others. Not being familiar with the habits of the other species enumerated I can give no definite idea as to the best ways to catch them, but should think that some one of the preceding methods would apply.

The cyanide bottle is, of course, the most satisfactory way of killing them. *On no account should they be killed in alcohol.* This fluid distorts and discolors them, making them unfit for mounting. However, as a preservative of specimens for anatomical purposes, it is possibly the best. Formalin is not good; as while it preserves the insect, it so hardens the tissues that they become extremely brittle, even when wet. For mounting on pins, when it is not possible to do it in the field or for the moment, the water bugs should be kept dry, being put between layers of cotton protected by soft tissue paper, this

being also the best way of packing them for transportation. To soften them, they can be put with perfect safety into a little cold water, and in the course of an hour or so they will be sufficiently relaxed to be pinned without danger of breaking off legs, etc.

Living *Notonectæ* for breeding or study should be put in a clean, dry tin box with a little excelsior in it to give them something to cling to, so they may not be too much shaken about or huddled together, which wets them and seems to be otherwise hurtful to them. It is wise also to put in with them a small piece or two of moist water-weed, which seems to help to preserve them in good condition till the aquaria can be reached. When in captivity, they should be fed on living flies or other small insects, which can be dropped into the water near them. One or two flies a day apiece appear to be enough to keep them in good condition.

In preparing the list of distribution I have consulted the papers indicated in the appended bibliography, and they will be denoted by the number each title bears in this list, which follows each locality. Other sources will be denoted by name.

The genus *Notonecta* is peculiar for the lack of a sufficiency of fixed diagnostic characters to facilitate the separation of the species by means of tables. Color is unreliable to a degree, varying as it does with locality, age, condition, or even without any assignable cause in the same species. For instance, the general coloration of *Notonecta undulata* Say, our most common and widespread species, varies from pure white with yellow scutellum, greenish feet and claret-colored eyes, to an entire black color, the feet and eyes remaining the same, and the scutellum being also black, with gradual and almost imperceptible intergrades from one to the other form. Occasionally, *N. variabilis* Fieber is found with black fasciæ corresponding to those of *N. undulata*, to such a degree that it may be taken for a dwarf form of the latter. In view of this, Kirkaldy has proposed as a diagnostic characteristic the proportion of the distance between the eyes at the front, which he has called the vertex, to the distance between the eyes at the base of the head, at the most constricted part, which he has denoted by the term *synthlipsis*. In practice, and I have made hundreds of measurements, I have found this proportion to hold good in each species within very narrow limits of variation; and in connection with the length of the insect and the proportional length and breadth of the pronotum and scutellum, it affords an excellent means

for separating them. I have used this method in the diagnostic tables following, being of the opinion that in general, proportional measurements of the hardened chitinous skeleton will be found to be constants in the majority of insects, and being more permanent than other characters, give an at all times reliable standard for the separation of species. This theory has not had the test of extended practical experience, except in this group, where hundreds of measurements have born out its efficiency.

Analytical Tables.

Family NOTONECTIDÆ.

Rostrum 3- to 4-jointed, first pair of legs inserted on the posterior margin of the pronotum, scutellum large.

KEY TO THE SUBFAMILIES.

Hind tibiæ and tarsi ciliated, abdomen keeled, hairy, eyes very large, conspicuous. *Notonectinæ.*

Hind tibiæ and tarsi apparently not ciliated, abdomen neither keeled nor hairy, rostrum 3-jointed, eyes small..... *Pleinæ.*

Subfamily NOTONECTINÆ.

KEY TO THE GENERA.

Eyes not contiguous at base, posterior femora not reaching the apex of the hemelytra. Pronotum not very transverse, wings present, hemelytral area distinct.

1 (2) Last segment of the antennæ much shorter than penultimate, hind tarsi without claws ..... **Notonecta.**

2 (1) Last segment of the antennæ much longer than the penultimate, hind tarsi with claws ..... **Buenoa.**

Genus NOTONECTA Linné.

SYNOPSIS OF SPECIES.

1 (7 and 10) Small species, subrobust.

2 (5) Vertex twice or less than twice the synthlipsis.

3 (4) Vertex 1½ to two times the synthlipsis; width of pronotum one and three quarters times the length; width of scutellum one and one half times the length; length of insect 9.4 mm. to 11 mm. **indica.**

4 (3) Vertex twice the synthlipsis; width of pronotum one and four fifths times its length; width of scutellum one and one fifths times its length; length of insect 10.2 mm ..... **howardii.**

5 (2) Vertex more than twice the synthlipsis.

6 Vertex two and one half times the synthlipsis; width of pronotum twice its length; width of scutellum one and one fifth times its length; length of insect 10 to 13 mm ..... **undulata.**

7 (1 and 10) Small slender species.

8 (9) Vertex three times the synthlipsis; width of pronotum twice its length;

width of scutellum one and one third times its length; length of insect 8.2 to 10.2 mm ..... **variabilis.**

9 (8) Vertex six to eight times the synthlipsis; width of pronotum one and four fifths times its length; width of scutellum one and one sixth times its length; length of insect 10.7 to 12 mm ..... **uhleri.**

10 (1 and 7) Medium-sized robust species.

11 (14 and 17) Vertex at least three times the synthlipsis.

12 (13) Vertex three to four and one half times the synthlipsis; width of pronotum two and one half times its length; width of scutellum one and one half times its length; length of insect 11 to 14 mm. **mexicana.**

13 (12) Vertex three times the synthlipsis; width of pronotum twice the length; width of scutellum one end one quarter times its length; length of insect 12.1 to 14.4 mm..... **irrorata.**

14 (11 and 17) Vertex less than three times the synthlipsis.

15 (16) Vertex two to two and one half times the synthlipsis; width of pronotum twice the length; width of scutellum one and one fifth times the length; length of insect 12.1 to 17 mm..... **lutea.**

16 (15) Vertex two and one half times the synthlipsis; width of pronotum one and six sevenths times its length; width of scutellum one and one fifth times its length; length of insect 13.1 to 14 mm. **montezuma.**

17 (11 and 14) Vertex not twice as wide as synthlipsis.

18 (19) Vertex one and one third times the synthlipsis; width of pronotum one and two thirds times its length; width of scutellum one and one third times its length; length of insect 8 to 13 mm. **shooterii.**

19 (18) Vertex but slightly wider than synthlipsis; width of pronotum twice the length; width of scutellum one and one fifth times the length; length of insect 12.6 to 15.5 mm..... **insulata.**

1. Notonecta indica Linné.

Notonecta indica.

1771. Linné, "Mantissa Plantarum," p. 534.
1900. Kirkaldy, "Entomologist," p. 10.*
1904. Kirkaldy, "Uber Notonectiden," Wien. Ent. Zeit., p. 94.

N. americana.

1775. Fabr., Syst. Ent., p. 690, etc.*
1811. Ol., Enc. Méth., VIII, p. 389 *
1886. Uhler, Ch. List, p. 28.
1894. Uhler, P. Z. S., Lond., p. 223.
1897. Kirk., Rev. Not., Tr. Ent. Soc. Lond., p. 408.
1901. Champ., Biol. C.-A., Rhynch. II, p. 370, Tab. 22, fig. 11, female.

N. unifasciata.

1857. (?) Guérin, Le Moniteur, p. —.*
1858. Guérin, Bull. Soc. Zool. Acclim., IV, p. 581.
1897. Kirk., Tr. Ent. Soc. Lond., p. 426.

Description. — "Head rather large, notocephalic lateral margins straight, not very divergent from the base; vertex varying from one and one half to twice as wide as synthlipsis. Scutellum rather shorter than in *N. undulata* Say. Hemelytra variable: (1) fulvous or dark stramineous, with a broad black fascia near the apex, occupying the basal two thirds of the membrane and the apex of the corium; (2) varying from bluish black to violet brown, the corial margins of the clavus and a broad irregular blotch about the middle of the corium, fulvous or dark stramineous. Otherwise like *N. undulata* Say." (Kirk., Rev. Not., p. 409.)

Long., 9.4 to 11 mm., lat., 3.4 to 3.6 mm.

Distribution. — United States (49), St. George, Utah (coll. mea), Humboldt Lake, Nevada (coll. mea and Van Duzee), Keeler Co., California (coll. Van Duzee), Arizona (coll. Heidemann and U. S. N. M.), Los Angeles, California (U. S. N. M.), Claremont, California (coll. mea), Rogue River, Oregon (U. S. N. M.), Alpine, Texas (O. S. U. coll.). This bug is extremely abundant in Lake Texcoco, Mexico, where its ova together with those of one or two Corixas are used as food under the name of "huautle." It also occurs in Cuba, according to Kirkaldy.

The notocephalon, in conjunction with the size and coloration, will in the majority of cases serve to separate *Notonecta indica* Linné from *N. undulata* Say. As to color, however, there are some individuals from California in the U. S. National Museum collection, that of Mr. E. P. Van Duzee and my own, of the pure moonlight color of *N. undulata* var. *maculata*, from which, however, they are separated by the cephalic and pronotal structure. The Los Angeles *N. indica* grade from the typical broad black band across the corium to pure white, being in this somewhat similar to the variations in *N undulata*. The average length of the insect is about 10 mm., although Kirkaldy gives it as ranging to 11 mm., and in the National Museum there is one specimen that measures only 9.4 mm.

2. Notonecta howardii, new species.

Head. — Notocephalic lateral margins curved; vertex twice as wide as synthlipsis; base of eyes about twice as wide as synthlipsis. Pronotum four fifths broader than long, humeral and lateral margins sinuate. Scutellum one fifth longer than wide, not concolorous. Hemelytra clouded with black going into smoky, and with a broad black band across the membrane and the apex of the corium. Apex of the membrane smoky. Corium and clavus moderately clothed with a golden pubescence. Membrane lobes subequal. Pedes: Intermediate femoral spur small, rather blunt, concolorous.

Measurements. — Vertex, 1 mm.; synthlipsis, .5 mm.; pronotum, lat., 3.5 mm., long., 1.9 mm.; scutellum, lat., 2.7 to 2.9 mm., long., 2.2 to 2.4 mm.; insect, long., 10.2 mm., lat. (pron.), 3.5 mm.; types, No. , U. S. N. M.

Described from two specimens in the U. S. National Museum, collected by Dr. E. A. Mearns in Arizona.

This waterbug is intermediate between *Notonecta indica* Linné and *N. undulata* Say. From the former it may be distinguished at once by the head characters; and the pronotum and scutellum will serve to separate it from the latter.

The preceding description is perforce very brief, as there were only the two somewhat old specimens to draw it up from, and I did not venture to spread the wings or otherwise prepare them for fear of destroying the insect. The colors are not mentioned (except black), as they change in old specimens and those preserved in alcohol; and the living or freshly caught insect may be very different in hue from those before me. Color characters, as pointed out in the introduction, are unreliable and misleading.

It affords me sincere pleasure to dedicate this, my first described insect, to Dr. L. O. Howard, to whom I am indebted for many kindnesses and much goodwill.

3. Notonecta undulata Say.

Notonecta undulata.

1832. Say, Descr. n. sp. Het. Hem., N. A., Fitch reprint, p. 812 LeComte Ed. Comple. Writ., 1859, p. 368, vol. I.
1851. Fieb. Rhynchographieen, p. 55 (of separate).
1851. Fieb., Gen. Hydroc, p. 26 (of separate).
1874. Packard, Half hrs. w. Insects, pt. 5, pp. 139–41, fig. 103; ova, p. 159.
1875. Uhl., Bull. U. S. Geol. Surv. (2), V, p. 239, pl. 2, fig. 33.*
1876. Glover, Ms. Notes, p. 54, pl. V, fig. 9.
1877. Uhl., Bull. U. S. G. & G. Surv., Bull., vol. 3, No. 2, p. 453.
1878. Uhl., Bull. U. S. G. & G. Surv., vol. IV, p. 509.
1878. Uhl., Proc. Bost. Soc. N. H., vol. XIX, p. 442.
1883. Packard, Guide, p. 537.
1885. Uhl., Stand. N. H., vol. II, p. 252 (partim).
1886. Uhl., Ch. List, p. 28 (partim).
1888. Comstock, Introduction, p. 186, fig. 157.
1889. Weed, Bull. Ohio Agr. Sta., Tech., Ser. I, p. 12, pl. 1, fig. 3.
1889. Garman, Bull. Ills. Laby. N. H., art. IX, vol. III, p. 174.
1891. Summers, Bull. Agr. Exp. Sta., U. of Tenn., vol. IV, No. 3, p. 82.
1890. Hyatt & Arms, Insecta, p. 121, fig. 70.
1894. Uhl., Proc. Calif. Acad. Sci., 2, vol. IV, p. 292.
1894. Van Duzee, Bull. Buff. Acad. Nat. Sci., vol. V, No. 4, p. —.
1895. Gillette & Baker, Bull. 31, Colo. Agr. Exp. Sta., Tech. Ser. 1, p. 63.
1897. Kirk., Tr. Ent. Soc. Lond., p. 410.
1897. Smith, Ins. N. J., p. 144.
1899. Packard, Ent. for Beginners, p. 83.
1899. Comstock, Manual, p. 130, fig. 49.
1900. Osborn, Contr. Dep. Zool. and Ent. O. S. U., No. 2, p. 79.

1900. Lugger, Bull. 69, Ent. Div., U. of Minn., Agr. Coll. Exp. Sta., p. 15.
1901. Champion, Biol. C.-A., Rhynch., vol. II, p. 370, tab. 22, fig. 10, male
1901. Howard, Insect Book, p. 275.
1902. Bueno, Jour. N. Y. Ent. Soc., vol. X, pp. 231 and 233.
1904. Kirk., Wien. Ent. Zeit., pp. 94, 95 and 132.
1905. Bueno, Jour. N. Y. Ent. Soc., vol. XIII, p. 45.

N. americana.

1789. Gmel., in Linné Syst. Nat., ed. XIII, p. 2118.*
1853. Herr.-Sch., Wanz. Ins., IX, p. 44, pl. 294, fig. 902 (nec Fabr).*

N. punctata.

1851. Fieb., Abh. Bohm. Ges. Wiss. (5), VII, p. 476 (in part).
1886. Uhl., Ch. List, p. 28.

N. variabilis.

1851. Fieb., l. c., p. 477 (in part).
1856. Guér., in La Sagra's Hist. de Cuba, vol. VII, p. 176.*

N. virescens.

1852. Blanch., in Gay's Chile, Zoöl., vol. VII, p. 233.*

N. pallipes.

1881. Leth., Ann. Soc. Ent. Belg., vol. XXV, p. 13 (nec Fabr.).

Description. — "Head diverging curvedly (varying in degree) from the synthlipsis, which is not quite two and a half times less wide than the vertex. Pronotum very similar to that of *N. glauca* Linné, but the humeral margins as a rule not distinct. Scutellum not quite one fourth shorter than the metanotum, varying in color from pale luteous to black, with divers intermediate arrangements of the two colors; similar hemelytral markings occurring with dissimilarly colored scutella and vice versa. Metanotum varying from luteous to black, with three or more dark castaneousst ripes; scutellar margin luteous. Hemielytra exceeding variable, giving rise to a number of well-marked varieties, though these are linked together by intermediate forms." (Kirk., Rev., p. 410.)

Long., 10 to 13 mm., lat. 3 to 4 mm.

Distribution. — My collection: Wood's Holl, Mass., Providence, R. I.; Long Island, N. Y., Staten Id., N. Y.; New York City, N. Y.; Putnam Co., N. Y.; Palisades, Rahway R. and Delair, N. J.; Raleigh, N. C.; Baltimore, Md.; Washington, D. C. (also colls. Heidemann and U. S. N. M.); Laval Co., Quebec, Canada; Lake Forest, Chicago and Urbana, Ills.; Onaga and Douglas, Kansas; Paige, Texas; Phoenix, Arizona; Bearfoot Mts., B. C.; Dilley, Oregon; Pasadena, Salton, and Three Rivers, California; Moscow, Idaho (coll. Van Duzee). Collection Heidemann: Maryland, Texas, and St. Kitt's, W. I. Collection U. S. National Museum: Rhode Island, Illinois, Indiana, Kansas, Central Missouri, Virginia; Lincoln, Nebraska; Louisiana, New Mexico, Colorado. Collection Ohio State University: Cedar Bluffs, Nebraska; Ames, Iowa. Albany, N. Y. (Coll. N. Y. State Mus.). Mt. Katahdin, Me. "U. S." (49), Buffalo, N. Y. (53), Madison and Caldwell, N. J. (38), Wauseon and Columbus, Ohio (31); Missouri and Indiana (37); Tennessee (39); Milk River Region, Montana (44); Shasta Co., California (51); Ft. Collins and Denver, Colorado (13); Sloan's Lake, Colorado (42). Minnesota (34); Michigan; Kentucky; Utah.

Notonecta undulata Say is by far the most widely-spread species to be found in America. It ranges from British Columbia down throughout the continent, spreading east and south and ranging down into Chile (according to Kirkaldy, Rev. Not.). The characters given under the preceding species serve to distinguish it from them and from *N. variabilis*, although small, white specimens of *N. undulata* may be confused with the latter. Kirkaldy has proposed three color-varieties for this bug, calling the pure white, or moonlight, color, with a sienna brown dot at the base of the membrane, var. *maculata;* the form with black fasciæ at the junction of the corium and membrane, var. *undulata:* and the fasciated form with corium suffused with black, var. *charon*. While these terms are somewhat useful, it is nevertheless impossible to draw a definite line between the various forms. In a long series, all intergrades are to be found, from the pure white, or moonlight color before mentioned, to an insect nearly all black, except for a little white on the clavus and corium, and a small, nearly round spot at the apex of the corium, next the membrane. There are in the National Museum collection five specimens from Louisiana collected by C. F. Baker, in which a broad black band occupies the posterior portion of the corium and the entire membrane. I have recently received this form from Dr. R. E. Kunzé, from Phoenix, Arizona. Otherwise, it is indistinguishable from the typical insect. Another specimen in the same collection, from Salt Lake, Utah, while having the notocephalic and pronotal structure of this species, in general contour and color may be taken for *Notonecta variabilis*. In the American Museum of Natural History, there is a specimen from Guadalajara, Mexico, which is practically entirely black, varying in tone from deep velvety to brownish black, where in typical specimens the white markings are.

As previously mentioned, this is the most common species of America and easily obtainable at all times. I have endeavored to breed it but have not succeeded in carrying it beyond the second or third instar, owing to the lack of proper food. However, having obtained a number of ova, I give the following description:

Ovum. — Length, 1.9 to 2 mm. Clear glistening pearly white when recently deposited. Chorion sculptured in irregular hexagons. Shape, elongate oval.

The only other descriptions known to me are a brief note by Prof. H. Garman in Bulletin Illinois State Laboratory of Natural History, Vol. III, where on page 174 he says the following: "The

eggs, which are elongated, cylindrical, and white, are attached to aquatic plants." Professor Packard, in "Half Hours with Insects," V, p. 159, also briefly refers to the ovum.

I have seen one *N. undulata* in the act of ovapositing, but not knowing what she was doing until too late, all I noticed was an in and out motion of the terminal abdominal segments, lasting possibly half a minute. When she swam away, there was the pearly white egg. I have frequently noted the parenchyma of the weeds slightly abraded, and in the groove thus formed, the ovum is placed.

4. Notonecta variabilis Fieber.

N. varibilis.

1851. Fieb., Abh. Bohm. Ges. Wiss. (5), VII, p. 477 (in part).
1879. Berg, Ann. Soc. Cien. Arg., VIII, p. 74. (Reprint, p. 197.)
1897. Kirk., Tr. Ent. Soc. Lond., p. 414.
1902. Bueno, Journ. N. Y. Ent. Soc., vol. X, pp. 231 and 234.
1904. Kirk., Wien. Ent. Zeit., pp. 94 and 95.
1905. Bueno, Journ. N. Y. Ent. Soc., vol. III, p. 45.

N. undulata.

1885. Uhl., Stand. Nat. Hist. vol. II, p. 252 (in part).
1886. Uhl., Ch. List, p. 28.

N. americana.

1899. Ashm., in Smith's Ins. N. J., p. 144.

Description. — "Head, notocephalic lateral margins diverging curvedly from the narrow base, vertex about three times as wide as synthlipsis. Pronotum, width of posterior margin not quite twice as great as the length of the pronotum. Hemelytra, clear white inclining to yellowish, with a golden pubescence. Alar nervures pale golden yellow. Pedes and abdomen as in *N. undulata* Say." (Kirk., Rev., p. 414.)

Long., 8.2 to 10.2 mm., lat., 3.2 to 3.7 mm.

Distribution. — My collection: Van Cortlandt Pk., Ithaca, Putnam Co., Staten Island, N. Y.; Palisades, Rahway, R., Westfield, and Delair, N. J.; Chestnut Hill, Pa.; Lake Forest, Fourth Lake and vicinity of Chicago, Illinois; Washington, D. C.; Glen Echo and Bladensburg, Maryland; Montreal, Quebec; Raleigh, N. C. Hatch Experiment Station Collection; Amherst, Massachusetts; Pennsylvania, and Maryland. U. S. National Museum Collection: Lake Maxicuche, Indiana, Wisconsin, Michigan, Kansas, Rhode Island. Ohio State University collection: Maine; Columbus and Ashtabula, Ohio; Cedar Bluffs and Pine Ridge, Nebraska.

Notonecta variabilis Fieber is readily distinguishable from *N. undulata* by its smaller size, the largest *N. variabilis* barely equalling the smallest *N. undulata;* by the form being generally more slender; and by the shape of head and proportions of the notocephalon. At times, one meets an individual with black fasciæ somewhat resembling *N. undulata*, but the black is less bright and the markings less clean

cut. The general characters given will serve to separate it in all cases of doubt. There are in my collection some specimens in which the hemelytræ are stained a peculiar brownish black from the water, to a greater or less degree. In the national museum collection, there is a remarkably small specimen from southern California. It approaches in form and size *N. undulata*, var. *virescens*, from which, however, it can be readily separated by the notocephalic structure. It is only 8 mm. long and 2.8 mm. wide.

Prof. Uhler, according to his letters to Mr. Kirkaldy, is of the opinion that this species, *N. undulata* Say, and *N. indica* L. are mere varieties. But on the other hand, I have in my collection long series of both *N. undulata* and *N. variabilis* taken in this locality, and have never met with an intermediate form among them. On the contrary, I have found them always very constant to type. Then again, wherever *N. undulata* was found abundantly, *N. variabilis* was absent; and where I found large numbers of *N. variabilis*, I have taken not more than three or four *N. undulata* altogether. In my opinion, *Notonecta variabilis* Fieber is a good species, entirely distinct from *Notonecta undulata* Say.

The life-history of this water-bug, in common with all others of the family, is unknown. Breeding experiments have given me the ovum, which is very similar to that of *N. undulata*, except that it is naturally smaller, and perhaps a little more slender in proportion. I can also hazard a guess as to the number of stages, from field material and give approximately the period of embryonal development. Oviposition begins early in the spring, and continues thereafter, how late, I am unable to say. The ovum is deposited in a similar manner to that of *N. undulata*, mentioned previously, and the period of incubation is some 22 days on an average; this varies according to the conditions and temperature. Females in my aquaria have deposited some 30 ova each, but this cannot be an exact figure. The bugs arrive at maturity in the late July or early August, as shown by captures of recently transformed individuals. From nymphs taken at the same place on same date, it would appear that there are five nymphal instars, or perhaps, six. The adults pass the winter concealed in the mud at the bottom of the pools they frequent, emerge in the spring as soon as the ice is melted, and immediately begin to breed.

5. Notonecta uhleri Kirkaldy.

Notonecta uhleri.

1897. Kirk., Ann. Mag. N. H. (6), XX, p. 58.*
1897. Kirk., Tr. Ent. Soc. Lond., p. 415.
1902. Bueno, Jour. N. Y. Ent. Soc., vol. X, pp. 231 and 235.
1904. Kirk., Wien. Ent. Zeit., p. 132.
1905. Bueno, Jour. N. Y. Ent. Soc., vol. XIII, p. 46.

Description. — "Head: notocephalon in the form of an inverted wine-decanter, margins greatly curved, widely diverging toward the vertex, which is six to eight times wider than the synthlipsis, at which point, the eyes are almost contiguous; breadth of the eye about ten times as great as that of the synthlipsis. Pronotum: humeral angles acute, accentuated, lateral margins sinuate, humeral margins little separate from the posterior margin. Metanotum dark purple-brown. Hemielytra varying from dark brick-red to rich orange-yellow; a large irregular black blotch at the base of the corium extending transversely and nonacuminately from the apex of the clavus to the golden-yellow exocorial lateral submargin; membrane dark red-brown, apically black — this tint encroaching more or less basally. Alar nervures brown. Pedes: coxæ blackish; intermediate tibial spur blunt, subcylindrical. Abdominis dorsum: first and second segments rufotestaceous, deeper marginally, the remainder flavotestaceous, lurid marginally; this latter tint encroaching more and more apically. Abdominis venter rufotestaceous, densely provided with greenish black cilia." (Kirk., Rev., p. 415.)

Distribution. — Massachusetts (Uhler, Montandon and British Museum), New Orleans (Paris Museum), Florida (Uhler). My collection: Van Cortlandt Pk., New York (also colls. U. S. N. M., Davis and Heidemann); Putnam Co., N. Y.; Washington, D. C. (also coll. Heidemann); Palisades, N. J. "La.," U. S. N. M.

Notonecta uhleri was first described by Kirkaldy in 1897 (l. c.), from a male in the Uhler collection. It is a very rare bug, but so characteristic that its late description is remarkable. I have found records of only twenty-five specimens of this insect in collections, of which the type and one other are in Prof. Uhler's collection, a cotype in Mr. Kirkaldy's, two specimens in Mr. Otto Heidemann's, three in the U. S. National Museum, two in the British Museum, one in the Paris, another specimen in the collection of Mr. W. T. Davis, and the remaining thirteen in mine.

This waterbug is very noticeable on account of its bright color and peculiar notocephalic structure. It is impossible to mistake it for any other, although it approaches *N. variabilis* somewhat in size and general contour. I have touched on its habits previously, and nothing is known of its life-history or development. I have, however, gotten ova from a female taken in this vicinity, and they are undistinguishable from those of *N. variabilis*.

6. Notonecta mexicana Amyot & Serville.

Notonecta mexicana.

1843. A. & S., Hist. Nat. Ins., Hem., p. 453, pl. 8, fig. 7.
1853. Herr.-Sch., Wanz. Ins., IX, p. 43, pl. 294, fig. 903.
1884. Uhl., Stand. N. H., p. 252.
1886. Uhl., Ch. List, p. 28.
1894. Uhl., Proc. Cal. Acad. Sci., ser. 2, vol. IV, p. 292.
1895. Gillette & Baker, Bull. 31. Colo. Agr. Exp. Sta., Tech. Ser. I, p. 63.
1897. Kirk., Tr. Ent. Soc. Lond., p. 401.
1901. Champ., Biol. C.-A., Rhynch. II, p. 368, Tab. 22, figs. 6, 6*a–d*.
1904. Kirk., Wien. Ent. Zeit., p. 94 and 132.

N. klugii.

1851. Fieb., Abh. Bohm. Ges. Wiss. (5), VII, p. 474.

Description. — "Head narrow at base, parallel for a short space, then sinuately diverging; vertex from three and one half to four and a half times as wide as synthlipsis. Pronotum very transverse, about two and one half times wider than long, lateral margins slightly sinuate, humeral margins gently and elongately curved, posterior margin not sinuate; humeral angles acute, accentuated. Metanotum not quite half as long again as scutellum, black (dark vars.) or violet brown margined with luteous (pale vars.). Hemielytra varying in color, membrane lobes subequal. Alæ semitransparent, smoky, nervures brown (pale vars.), or semitransparent smoky black, nervures blackish-brown (dark vars.). Abdominis dorsum black (dark vars.), or rufoluteous with paler genital segments (pale vars.). Abdominis venter varying from black to testaceous." (Kirk., Rev., p. 401.)

Long., 11 to 14 mm., lat., 4.5 to 4.8 mm.

Distribution. — U. S. National Museum collection: Bright Angel, Hot Springs, and Catalina Mts., Arizona; California. My collection: Pasadena and Sta. Clara, California. "W. States" (49), Fort Collins, Colorado (13).

The shape of the head and the very transverse pronotum separate it very readily from the other species of the genus. In his revision, Kirkaldy goes at length into the color variations, and since his remarks cover the ground exactly, I reproduce them here: "The hemielytra are usually rich scarlet, with black membrane, but the latter hue often extends beyond the apical margins of the clavus and corium; the scarlet also varies much in shade, graduating in one direction to pale greenish-white through pale yellow, pale olive-green, deep yellow, orange, and pinkish, and in the other through crimson and violet-red to deep violet-black, though in the last, the sutures of the hemielytral divisions are usually narrowly violet-red; in some specimens the apex of the corium is black, from the base of the membrane to the margins of the hemielytra in a straight line, and the rest of the hemielytra are rich crimson. The hemielytra are rarely maculate, occasionally the center of the clavocorial suture has a more or less

pronounced black smudge about the center. It may be convenient to propose the varietal names *ceres* for the pale-colored forms and *hades* for the southern violet black race. Herrich-Schaffer (l. c., p. 43) notes a variety with a large central ochreous stripe on the scutellum, while Fieber (l. c., p. 475) describes among the varieties with red hemielytra: (1) "Schild schmutziggelb mit braunem grund," and (2) "Schild braun mit gelblichem rand" — these three varieties I have not seen. In the U. S. National Museum and Heidemann collections the specimens from Colorado Cañon, Hot Springs and Catalina Mts., Arizona, are var. *hades*, and above the average size and with more prominent eyes. In the National Museum there is a specimen from Mexico which has the scutellum with the yellowish base (or apex) mentioned by Fieber (l. c., p. 475).

7. Notonecta irrorata Uhler.

Notonecta irrorata.

1876. Uhler.
1876. Glover, Ms. Notes, p. 54.
1878. Uhl., Pr. Bost. Soc. N. H., vol. XIX, p. 445.
1883. Packard, Guide, p. 537.
1886. Uhl., Ch. List, p. 28.
1891. Summers, Bull. Agr. Exp. Sta., U. of Tenn., vol. IV, No. 3, p. 82.
1894. Van Duzee, Bull. Buff. Soc. Nat. Sci., vol. V, No. 4, p. 86.
1897. Kirk., Tr. Ent. Lond., p. 418.
1899. Smith, Ins. N. J., p. 144.
1900. Osborn, Contr. Dept. Zoöl. and Ent., O. S. U., No. 2, 8th Ann. Rept. O. St. Acad. Sci., p. 79.
1902. Bueno, Journ. N. Y. Ent. Soc., vol. X, pp. 231 and 235.
1904. Kirk., Wien. Ent. Zeit., p. 132.
1905. Bueno, Journ. N. Y. Ent. Soc., vol. XIII, p. 46.

N. ornata.

? Fitch Ms. (Signoret Coll.).*

Description. — "Head small, notocephalic lateral margins diverging widely, vertex a little more than three times as wide as the synthlipsis; width of vertex and of the eye subequal; eyes rather larger proportionally than in *N. triguttata*, etc. Pronotum much wider basally than apically, lateral margins not sinuate, humeral angles acute, humeral and posterior margins sinuate. Hemelytra rich black, irrorated (especially on the clavus) with refulgent yellow brown, anterior lobe of membrane and apex of exterior lobe, smoky. The irrorations vary greatly in different individuals; in some the corium and membrane are almost immaculate, in others the whole of the valvus and corium is irrorated, imparting a checkered appearance, while in others the clavus is rich (almost metallic) yellow-brown with faint distant narrow black lines. Alar nervures brown. Pedes: intermediate tibial spur small. Abdomenis dorsum: first to fifth segments black, sixth, seventh and eighth sordid grayish-brown. Abdominis venter black." (Kirk., Rev., p. 418.)

Long., 11.8 mm. to 14.4, lat., 3.6 to 4.7 mm.

Distribution. — My collection: Laval Co. and Montreal, Quebec; Ithaca, Putnam Co., Van Cortlandt, Staten Island and Long Island, N. Y.; Palisades, Rahway R., Westfield, and Delair, N. J.; Baltimore, Md.; Washington, D. C.; Lake Forest, Ills.; Columbus, Ohio (also recorded in 31). U. S. National Museum; Rhode Island; Lake Maxincuche and South Bend, Indiana. Buffalo, N. Y. (53), Tennessee (39), Madison, N. J. (38), and "U. S." (49). Keene Valley, N. Y. (State Museum), Wellington, Ohio, and Bladensburgh, Md. (Coll. Heidemann). Montana (Coll. Van Duzee). Michigan, Kentucky.

The habits of this handsome bug are covered in the first part of these notes. It may not be out of place to call attention to a peculiarity it possesses in common with the other colored forms of the genus. On being removed from the water it has an evanescent bluish tinge on the hemielytra, caused doubtless by the pile that covers them. The same phenomena I have noted in *N. uhleri* and *N. insulata*.

8. Notonecta lutea Muller.

Notonecta lutea.

1776. O. F. Muller, Zool. Dan., p. 103.*

1814. Fall., Hydr. et Nauc. Sweciæ, p. 6.

1851. Fieb. "Rhynchotographieen," Abh. Bohm. Ges. Wiss. (5), vol. VII, p 473. (Separate, p. 49.)

1851. Lieb. Gen. Hydroc., p. 26.

1860. Flor. Rhynch. Livl., vol. I, p. 774.*

1860. Fieb., Eur. Hem. (1), p. 100.

1875. J. Sahlbg., Not. Sallsk. Faun. Fenn. Forh., vol. XIV, p. 274.

1880. Puton, Hem. Fr., pt. 4, p. 218.

1891. Duda, Klub. prirod. Praze, p. 13, pl. IV, fig. 1.*

1897. Kirk., Tr. Ent. Soc. Lond., p. 425.

1904. Bueno, Ent. News, vol. XV, p. 220.

1904. Kirk., Wien. Ent. Zeit., p. 132.

N. unicolor.

1835. Herr.-Sch., Nomencl. Ent., p. 63.*

1848. Herr.-Sch., Wanz. Ins., vol. VIII, p. 23.*

Description. — "Head large, notocephalic lateral margins slightly diverging from the base, vertex two to two and a quarter times as wide as synthlipsis. Entirely luteous (except the dark claret eyes, occasional dark-brown markings along the sutures of the clavus, etc., the bronze-brown sternal hair-tufts, the black unguiculi and venter). Scutellum a third wider than long. Exterior lobe of membrane about half the size of the interior lobe and obviously not so long. Alar nervures luteous. Pedes: spine on intermediate tibia large, acute, black-tipped." (Kirk., Rev., p. 425.)

Long., 13 to 17.1 mm., lat., 4.5 to 5.5 mm.

Distribution. — In Europe, Lapland, Finland, Sweden, Bohemia, Austria; in Asia, Siberia. North America, Bearfoot Mts., B. C. These localities are all taken from the various works cited, except the American, which is from specimens in my collection.

The presence of *Notonecta lutea* in the northwestern extremity of this continent is one of the curious facts in faunistics that are used as arguments to bolster up theories. I express no opinion on it, beyond calling attention to the fact that no theory of importation by man can account for its presence here, since it is not one of the parasitic Hemiptera, and the only seemingly reasonable explanation is a migration by some obscure means.

9. Notonecta shooterii Uhler.

Notonecta shooterii.

1894. Uhl., Proc. Cal. Acad. Sci., 2d ser., vol. IV, p. 292.
1897. Kirk., Tr. Ent. Soc. Lond., p. 406.
1901. Champ., Biol. C.-A. Rhynch., vol. II, p. 368.
1904. Kirk., Wien. Ent. Zeit., pp. 94 and 132.

Description. — "Head short, notocephalic lateral margins slightly diverging from the base and slightly converging towards the vertex, which is about one third larger than the synthlipsis. Pronotum large, rather longer in proportion to its width than in the other species, lateral and humeral margins sinuate. Scutellum small, nearly one third shorter than the metanotum; black, base purple-brown. Sterna sordid rufo-testaceous, hair-tufts black. Hemelytra black; clavus (apex excepted) dull ivory-white, corium more or less concolorous, forming with the clavus a blotch of varying extent, and usually with a whitish spot along the apical margin, the claval and corial markings very similarly disposed to those of *N. triguttata*; apex of membrane, smoky. The hemielytra, vary, however, very much, being quite violet black in some individuals (*melæna*, var. nov.), while in others they are concolorous pale luteous. Membrane lobes always subequal in ordinary forms; generally unequal in the leucochroic varieties (*ochrothoe*, var. nov.), and rarely subequal (*tearca*, var. nov.). Alar nervures rich brown. Pedes: intermediate coxæ black, tibial spur small, rather blunt. Abdominis dorsum: segment 1 black, 2–5 violet-brown (the fifth apically black), 6 blackish, genital segments greenish-testaceous, all the segments more or less dull blackish laterally. Venter varying from green to black, carina and cilia black." (Kirk., Rev., pp. 407–8.)

Long., 8 to 13 mm., lat. pron., 4 to 4.7 mm.

Distribution. — San Diego, Cal., (51); Los Angeles, (U. S. N. M.), San Francisco (coll. Am. Mus. N. H. and mine), and Palo Alto, California. "California" (23).

Kirkaldy (l. c., p. 407), says: "Prof. Uhler informs me that in the U. S. National Museum there is a specimen of this species pure ivory-white. . ." I have had the good fortune to examine this and another similar specimen very closely. While in the absence of a long series and in deference to Prof. Uhler's determination they may for the time being be allowed to remain in this species, nevertheless they differ from the typical *shooterii* in being far more convex, the head apparently more flattened anteriorly, and in having a more

cylindrical pronotum. In typical examples the humeral angle is very distinct, but it is very much rounded and nearly obsolete in the leucochroic ones, both of which are from Mexico. The types of the bug are from California.

10. Notonecta montezuma Kirkaldy.

Notonecta montezuma.

1897. Kirk., Tr. Ent. Soc. Lond., p. 402.

1901. Champ. Bio. C.-A., p. 396, tab. 22, figs. 8, 8*a* ♂, 9 ♀.

1904. Kirk., Wien. Ent. Zeit., pp. 94 and 132.

Description. — Head narrow at base, similar to that of *N. mexicana*, notocephalic lateral margins fairly straight, diverging from the base, vertex two and a half to three times as wide as synthlipsis. Hemielytra orange-red, suffused (especially marginally) with crimson, and sparingly and irregularly marked with black; membrane bluish-black, apex brownish-black, lobes subequal. Pedes: coxæ brownish-black, intermediate tibial spur, small, rather blunt. Abdominis dorsum: segment 1 black, 2 sordid testaceous, suffused with crimson and margined with black. Venter black." (Kirk., Rev., pp. 402–3.)

Long., 13.1 to 14 mm., lat., 4.7 to 5 mm.

Distribution. — Havilah, California. (Am. Mus. N. H. coll.)

It is interesting to record this bug from the United States, and the American Museum of Natural History is to be congratulated in the possession of this unique specimen among the other rare things in the Henry Edwards Collection. The type is a specimen from Mexico in the Hope Museum, Oxford. There is another specimen in the Paris Museum. I am aware of no other records. This addition to our fauna makes this article practical for the separation of all the known American species of the genus *Notonecta*, except the South American *N. bifasciata* Guérin and *N. nigra*, described by Fieber from Brazil, the latter being represented by only three specimens in collections.

11. Notonecta insulata Kirby.

Notonecta insulata.

1837. W. Kirby, in Richardson's Faun. Bor. Am., Ins., p. 285. (Reprint 1878, Can. Ent., vol. X, p. 216).*

1851. Fieb., Rhychotographicen, Abh. köngl. böhm. Ges. Wiss. (5), VII, p. 475.

1875. Uhl., Rept. U. S. G. & G. Surv., vol. V, p. 841.

1876. Glover, Ms. Notes, p. 54 and pl. V, fig. 4.

1877. Uhl., Bull. U. S. G. & G. Surv., vol. III, no 2, p. 453.

1878. Uhl., Bull. U. S. G. & G. Surv., vol. IV, p. 509.

1878. Uhl., Proc. Bost. Soc. N. H., vol. XIX, p. 442.

1886. Uhl., Ch. List, p. 28.

1894. Van Duzee, Bull. Buff. Soc. Nat. Sci., vol. V, no. IV, p. 186.

1895. Gillette & Baker, Bull. 31, Tech. Ser. I, Agr. Exp. Sta., Ft. Collins, Colo., p. 63.

1897. Kirk., Tr. Ent. Soc. Lond., p. 403.

1899. Smith, Ins. N. J., p. 144.

1902. Bueno, Jour. N. Y. Ent. Soc., vol. X, p. 231–2.

1904. Kirk., Wien. Ent. Zeit., pp. 94 and 132.

1904. Uhl., Proc. U. S. N. M., vol. XXVII, p. 364.

1905. Bueno, Jour. N. Y. Ent. Soc., vol. XIII, p. 46.

N. impressa.

1851. Fieb., Abh. Bohm. Ges. Wiss., (5), vol. VII, p. 475.

1886. Uhl., Ch. List, p. 28.

N. rugosa.

1851. Fieb., l. c., p. 476.

N. fabricii.

1891. Towns., Proc. Ent. Soc. Wash., vol. II, p. 56 (nec. Fieb.).*

Description. — "Head; notocephalic lateral margins fairly straight and nearly parallel, very slightly constricted near the base; vertex little wider than synthlipsis, which is about one fourth less than the width of the base of the eye. Lateral and humeral margins of the pronotum sinuate. Scutellum varying slightly in length, but occasionally reaching and usually nearly reaching the base of the metanotum, black (Fieber in *N. rugosa* records two varieties (*cordigera* and *basalis*) with yellowish scutellum, but I have not seen them). Hemielytra variable in pattern and color * * * Alæ, basal nervures crimson, the others yellow-brown. Pedes: coxæ black, intermediate tibial spur small, slender, not tipped with black. Abdominis dorsum: segment 1 black, 2–6 brilliant scarlet, 7–8 reddish-testaceous. Abdominis venter black, connexivum and central carina green." (Kirk., Rev., pp. 403–4.)

Long., 12.6 to 15.5 mm., lat., 4.8 to 5.6 mm.

Distribution. — My collection: Montreal, Quebec; Bearfoot Mts., B. C.; Dilley, Oregon; Woods Holl, Mass.; Albany, Long Island, New York City and Staten Island, New York; Delair and Palisades, N. J.; San Luis Obispo, Claremont, Mt. Diablo, Santa Clara Co. and Pasadena, California; Humboldt Lake, Nevada (also in coll. Van Duzee); Ft. Collins, Colorado (also Van Duzee coll.); U. S. National Museum Collection: Hartford, Conn.; Indiana; Nebraska; Flagstaff, Arizona; Colorado; Las Vegas, New Mexico; Warner Lake, Oregon; Salt Lake, Utah; Palm Springs, Placer County, Santa Barbara and San Diego, California. Collection Heidemann: Palo Alto, California; Lakeside, S. D. Collection Ohio State University: Maine; Pine Ridge, Nebraska; Peach Springs, Arizona. Black Hills, Dakota (Am. Mus. N. H.); Orono, Maine, and Andover, Mass. (Hatch Exp. Sta.); Da Costa, N. J. (38); Buffalo, N. Y. (53); Denver, Colorado (13); Owens Valley, California (43); Milk River region, Montana (44); Las Vegas Hot Springs, New Mexico (52). I have also seen specimens from Mt. Katahdin, Maine.

Kirkaldy recognizes five color varieties (omitted in the preceding copy of his description), but while such terms may at times be convenient, it is as difficult in this species, as it is in *N. undulata* to draw a fixed line of demarkation to separate them. It ranges through vari-

ous degrees of fuscous, greenish-white and testaceous, all more or less marked with black, which color, however, is sometimes absent. Prof. Uhler at one time was of the opinion that the European *N. glauca* L. was to be found in America, basing it on the light-colored unicolorous individuals that are at times to be found in the Eastern United States. Individuals from mountainous regions are in general somewhat stouter in form, with flattened heads and more strongly arched pronotum.

I wish here to express my gratitude to the gentlemen who have in many ways most kindly helped me in this work: To Dr. L. O. Howard for the privilege of working over the U. S. National Museum material; to Mr. George W. Kirkaldy for much encouragement and valuable assistance in many ways; to Professor Herbert Osborn, Mr. Otto Heidemann, Mr. E. P. Van Duzee, Prof. H. T. Fernald, and many other gentlemen for gifts and loans of specimens.

In conclusion, I may say that the deficiencies of this article are very evident to me. It had been planned on more extensive and minute lines, but the unfortunate difficulty in obtaining material from our Southern and Western States has put such work out of the question for the time being. Therefore, I determined to present to observers such of my partial results as were in a more advanced stage, in order to arouse interest and make possible the completion at some later date of a genuine monograph of the entire family for the region I treat of here. For the same reason, I have reproduced in extenso Mr. Kirkaldy's descriptions, as they are so excellent that with them the work of identification of the species is much simplified; and also, I wished to make them accessible to American workers. I trust that my work will be of help to all who avail themselves of it.

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EXPLANATION OF PLATE VII.

Fig. 1. *Notonecta indica* Linné.

Fig. 2. *Notonecta undulata* Say.

Fig. 3. *Notonecta variabilis* Fieber.

Fig. 4. *Notonecta uhleri* Kirkaldy. (Drawn from cotype.)

Fig. 5. *Notonecta mexicana* Amyot & Serville var. *ceres* Kirkaldy. (Drawn from cotype.)

Fig. 6. *Notonecta irrorata* Uhler.

Fig. 7. *Notonecta lutea* Müller.

Fig. 8. *Notonecta shooterii* Uhler.

Fig. 9 *Notonecta insulata* Kirby.

All enlarged three diameters.

PROCEEDINGS OF THE NEW YORK ENTOMOLOGICAL SOCIETY.

MEETING OF NOVEMBER 15, 1904 (continued from page 102).

Mr. Davis read a letter from Mrs. Annie Trumbull Slosson, in which she stated that she had taken in pools of brackish water in southern Florida, an undetermined *Limnobates*, a specimen of which she sent for comparison with *Limnobates lineata* spoken of by Mr. Bueno. She also referred to her finding of *Halobates wullersterfi* on the beach at Lake Worth, Fla. She published a record of this in 1901 and no other record is known of their occurring on land, their usual habitat being far out at sea. She also sent specimens of *Brenthus anchorago* to show the great variations in size, remarking that she had taken it in numbers in its breeding places under the bark of gumbo-limbo (*Bursera gummifera*) but had also found it frequently on